Analysis of the sustainability of artificial soil constructions for urban landscaping.

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Introduction:

Soil should be considered more in urban landscape construction since soil can have a positive and negative influence on urban landscape planting. On the one hand, the soil is the main source of nutrients and physical support for plants. On the other hand, plants can be also affected by urbanization and different anthropogenic factors in soil such as soil contamination, salinization, acidification and over compaction. Due to these different anthropogenic factors, emission of greenhouse gases can increase which influence not only the landscape sustainability but also urban climate.

Aim: To analyze the sustainability of artificial soil constructions for urban landscaping purposes.

Tasks:

1. To measure the dynamics of CO2 fluxes from different soil construction
2. Influence of different anthropogenic factors (salinity, pollution, acidification, control) on CO2 emissions
3. To compare the moisture, soil temperature with the co2 fluxes
4. To select a suitable soil for urban landscaping

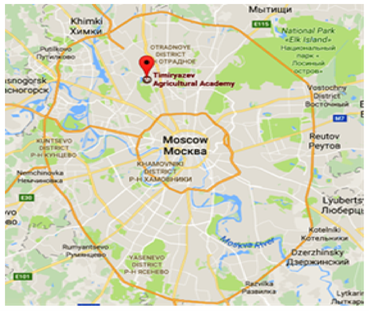
Object: Two research plots were chosen in Moscow, Russia for the experiments;

General information:

The climate of Moscow is moderately continental, with a clearly expressed seasonality. Winter (the period with an average daily temperature below 0 ° C) lasts about 4 months on average, from the second decade of November (November 10) to the second decade of March (March 20). The daytime temperature steadily returns to positive values on March 5. During the calendar winter, short (3-5 days) periods of severe frost may occur (with a night temperature of -20 ° C, rarely up to -25.- 30 ° C). In December and early January, thaws are frequent, when the temperature from -5.- 10 ° C rises to 0 ° C and higher, sometimes reaching values of +5. + 9 ° C.

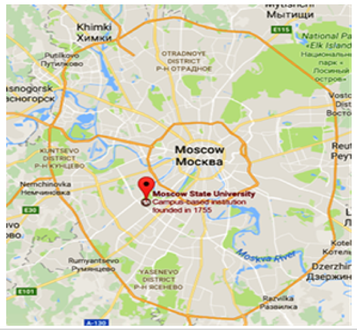
First experiment plot;

The first research sites which included soil constructions with different soil substrates such as turf, turf sandy loam (Tsl), turf + podzolic soil (Ts) with 2 different depths 5 cm and 20 cm is situated at the Russian State Agrarian University - Moscow Timiryazev Agricultural Academy (RSAU-MTAA), Moscow, Russia.

The second research plot:

The analysis of the impact with several anthropogenic (contamination, salinization, and acidification) factors on CO2 emissions in different soil constructions was carried out at the second site which is situated at the state Moscow university of Russia



Results

The dynamic of CO_2 in different soil constructions

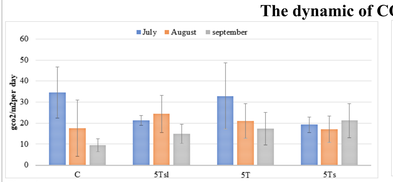


Figure 1

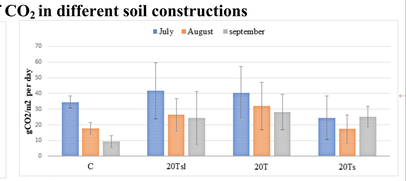


Figure 2

The carbon dioxide varies differently on every soil substrates, for example turf with 20 cm depths show a high amount of CO_2 fluxes than turf with a 5 cm depth during these 3 months which means that carbon dioxide can be reduced in urban areas by decrease the depths of turf soil for urban lawns. By comparing 5T with control, it can be said that from July to September the least amount of CO_2 flux has been measured in 5T then in control (fig 1and 2)

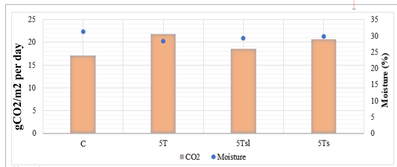


Figure 3

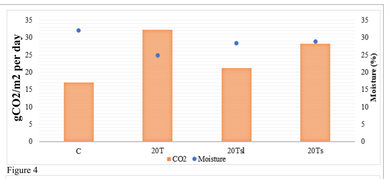


Figure 4

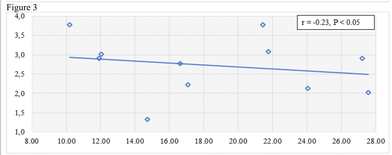


Figure 5. Correlation between the soil moisture and the CO_2 fluxes for Tsl with a depth of 5cm.

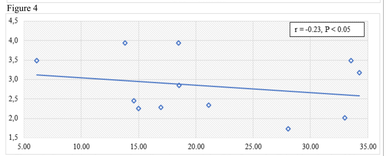


Figure 6. Correlation between the soil moisture and the CO_2 fluxes for Tsl with a depth of 20cm.

A comparison and correlation coefficient have been done to understand the dependence between the soil moisture and the CO_2 fluxes. If taking turf + sand as an example so it can be said that for Tsl 5cm is higher than the CO_2 as well as the Tsl 20 cm, whereas the moisture and the CO_2 for turf+ podzolic soil are almost the same (fig 3 and 4). To get a clear understanding of the relation between the soil moisture and the CO_2 for Tsl 5cm and Tsl 20cm, a correlation coefficient has been calculated and the result shows that the increasing of the CO_2 fluxes is not because of the soil moisture (fig 5 and 6).

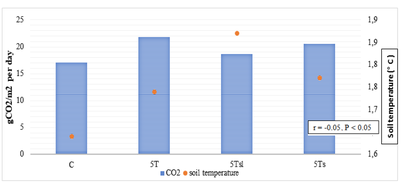


Figure 7

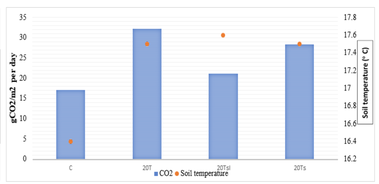


Figure 8

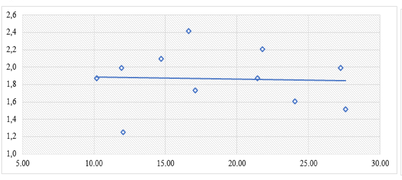


Figure 8. Correlation between the soil temperature and the CO_2 fluxes for Tsl with a depth of 5 cm.

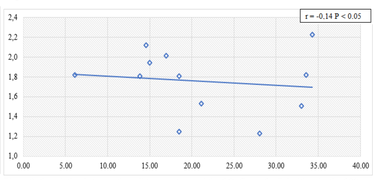
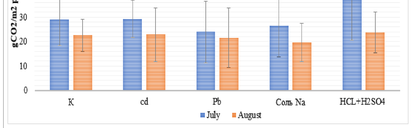
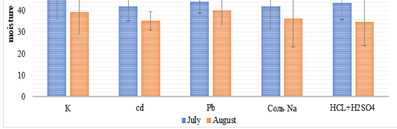


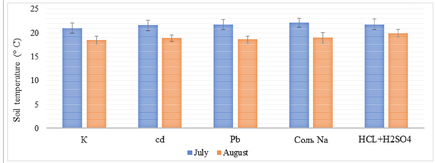
Figure 9. Correlation between the soil temperature and the CO_2 fluxes for Tsl with a depth of 20 cm.

A comparison and correlation coefficient have been done to understand the dependence between the soil temperature and the CO_2 fluxes. If taking turf + sand as an example so it can be said that for Tsl 5cm is higher than the CO_2 as well as the Tsl 20 cm, whereas the moisture and the CO_2 for turf+ podzolic soil are almost the same (fig 3 and 4). To get a clear understanding of the relation between the soil temperature and the CO_2 for Tsl 5cm and Tsl 20cm, a correlation coefficient has been calculated and the result shows that the increasing of the CO_2 fluxes is not because of the soil moisture (fig 5 and 6).

Influence of different anthropogenic factors (salinity, pollution, acidification, control) on CO2 emissions







The CO_2 measurement has been carried out for all the soil which are been anthropogenically disturb by heavy metals, salt, Hydrochloric acid mix with Sulfuric acid and control (podzolic soil) and the result show that the highest amount of CO_2 was for soil disturb with Hydrochloric acid mix with Sulfuric acid, the moisture and the soil temperature was low which means that the increasing of the CO_2 could be because of the radical degradation by Hydrochloric acid mix with Sulfuric acid

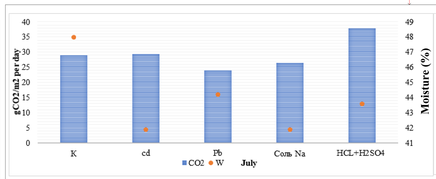


Figure 13

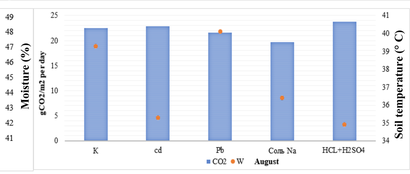


Figure 14

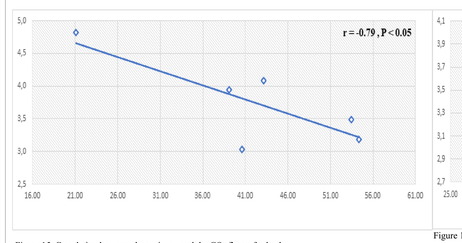


Figure 15. Correlation between the moisture and the CO_2 fluxes for lead.

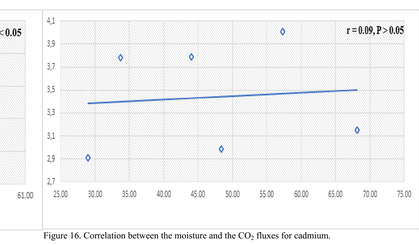
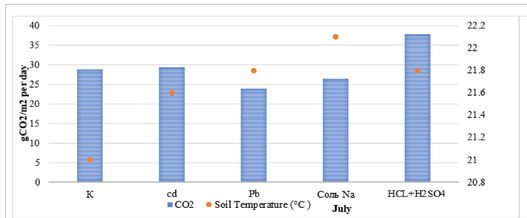


Figure 16. Correlation between the moisture and the CO_2 fluxes for cadmium.

A comparison and correlation coefficient have been done to understand the dependence between the moisture and the CO_2 fluxes. (fig 13 and 14) so the get a clear understanding between them the correlation coefficient has been calculated and the result show that only for soil which is been disturbed by cadmium has a positive correlation between the moisture and the CO_2 flux (fig 15 and 16).



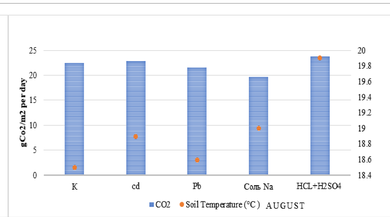
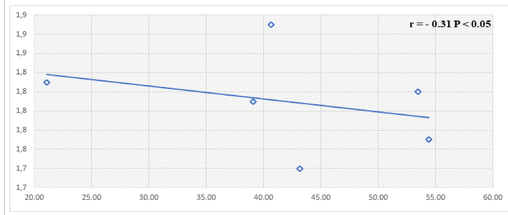
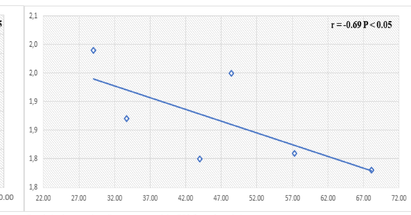


Figure 17

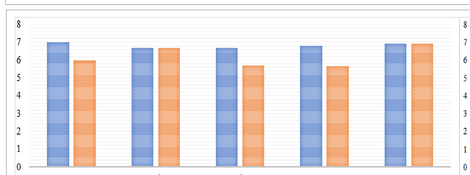


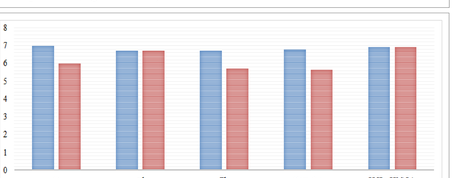
Correlation between the soil temperature and the CO2 fluxes for lead.

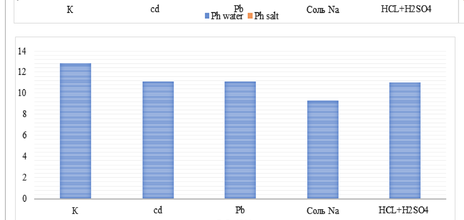


Correlation between the soil temperature and the CO2 fluxes for cadmium.

A comparison and correlation coefficient have been done to understand the dependence between the soil temperature and the CO2 fluxes (fig 17 and 18). To get a clear understanding between them the correlation coefficient has been calculated and the result show correlation between soil temperature and CO_2 fluxes is negative which means, that the increasing of CO_2 fluxes is not because on the soil temperature (fig 19 and 20)







There are some chemical properties have been analyzed to check the sustainability of the soils which have been anthropogenically disturb. By comparing the obtained result to the Russian standard of urban plantation PP 514, it can be said that only the soil which has been polluted by cadmium 107 mg/kg of potassium, and all the other chemical properties for all the soils are least which mean the these soil have a lack of fertilizers

Conclusion;

1. From the results, it can be concluded that urban soils are unstable, for example the CO_2 flux for turf with a depth of 5 cm was high in July and in September the CO_2 was low which means that turf soil with 5 cm is unstable.
2. The CO_2 for Turf mix with podzolic with a depth of 5 and 20 cm was lower than the others and during the 3 months the Co_2 flux was quite stable which means that turf mixed with podzolic soil can be used for urban landscaping
3. Acording to the obtained results for the soil which have been anthropogenically disturb should be restore because all the chemical properties are less then needed by comparing to the russian standard for urban plantation which means that the soil should be restore.